

**I/WE CLAIM:**

1. A process for optical filter construction, the process comprising the steps of:

- 5 growing amorphous silicon layers via self limiting pulsed molecular beam deposition;
- growing diamond-like carbon layers via an ion-based process;
- monitoring, during deposition, the layer growth, via interferometric technique capable of sub-angstrom resolution;
- 10 monitoring intrinsic stress using an in-situ cantilever-based intrinsic stress optical monitor;
- adjusting the intrinsic stress via deposition parameter modification;
- depositing the layers onto a substrate;
- monitoring indices of refraction during deposition via an in-situ ellipsometer;
- 15 measuring surface roughness using a reflection technique chosen from the group comprising: p-polarized reflection spectroscopy, phase modulated ellipsometry, and real-time atomic force microscopy;
- directing a focused beam of energetic oxygen ions across the diamond-like carbon at near grazing incidence; and,
- 20 repeating the process as necessary, alternating the silicon and carbon layers.

2. A process for optical filter construction, the process comprising the steps of:

- growing a high index layer;
- 25 growing a diamond-like carbon layer;
- monitoring layer growth;
- monitoring intrinsic stress;
- adjusting intrinsic stress, if necessary;
- depositing the high index layer onto a substrate;
- 30 depositing the diamond-like carbon onto the high index layer;

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monitoring indices of refraction;  
directing an ion beam onto the carbon layer; and,  
reducing the carbon layer until the carbon layer is approximately atomically  
smooth.

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3. The process of claim 2, wherein monitoring layer growth  
comprises the step of:

monitoring, during deposition, the layer growth via interferometric technique  
capable of sub-angstrom resolution.

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4. The process of claim 3, wherein monitoring intrinsic stress  
comprises the step of:

monitoring intrinsic stress using an in-situ cantilever-based intrinsic stress optical  
monitor.

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5. The process of claim 4, wherein adjusting intrinsic stress  
comprises the step of:

adjusting the intrinsic stress via deposition parameter modification.

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6. The process of claim 5, wherein monitoring indices of refraction  
comprises the step of:

monitoring indices of refraction during deposition via an in-situ ellipsometer.

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7. The process of claim 6, wherein after monitoring indices of  
refraction during deposition via an in-situ ellipsometer, the process comprises the step of:

measuring surface roughness using a reflection technique chosen from the group  
comprising p-polarized reflection spectroscopy, phase modulated ellipsometry, and real-  
time atomic force microscopy.

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8. The process of claim 7, wherein directing an ion beam onto the carbon coated high index layer comprises the step of:

directing a well-focused oxygen ion beam onto the carbon layer at near grazing incidence.

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9. The process of claim 8, wherein reducing the carbon layer until the carbon layer is approximately atomically smooth comprises the steps of:

rastering the ion beam in a sweeping fashion to allow interaction with only the carbon which protrudes above average surface height, the rastering being continued until the surface roughness is approximately less than 0.01 nanometers.

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10. An optical filter constructed using the process of claim 2.

11. An optical filter comprising:

a substrate;

a high index layer; and,

a planarized diamond-like carbon layer, the carbon layer having a surface roughness of less than 0.05 nanometers.

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12. The filter of claim 11, wherein the filter has alternating multiple layers of the high index layer and the diamond-like carbon layer.

13. The filter of claim 12, wherein the high index layer is silicon.

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14. The filter of claim 13, wherein the surface roughness is approximately less than 0.01 nanometers.

15. An atomic layer controlled optical filter system, the system comprising:

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atomically smooth.

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means for reducing the carbon layer until the carbon layer is approximately